REMARKS

Reconsideration of this application, as amended, is respectfully requested.

THE ALLOWABLE SUBJECT MATTER

The Examiner's indication of the allowability of the subject matter of claims 7 and 8 is respectfully acknowledged.

Claim 7 has been amended to be rewritten in independent form to incorporate the subject matter of claim 1 from which claim 7 formerly depended, and claim 8 has been amended to make some minor grammatical improvements. Accordingly, it is respectfully submitted that amended claims 7 and 8 are now in condition for immediate allowance. It is noted that in preparing claim 7 in independent form, minor revisions have been made to the recitation in original claim 1 in order to put claim 7 in better U.S. form. These revisions, however, are not related to patentability and do not narrow the scope of claim 7 either literally or under the doctrine of equivalents.

THE ABSTRACT

An abstract has been added on a separate sheet as required by the Examiner based on the abstract set forth in International Application No. PCT/SE00/00591 from which the present U.S.

National Phase application is derived. Accordingly, it is respectfully requested that the objection to the specification be withdr

THE DRAWINGS

As required by the Examiner, Fig. 4 has been added to show the feature of the present invention recited in claim 2 whereby reinforcement discs (23) are provided between every second magnetic disc (21), as supported by the disclosure in the specification at page 4, lines 12-15. Submitted herewith is a Letter to the Official Draftsperson requesting approval of new Fig. 4.

THE SPECIFICATION

The specification has been amended to add section headings and to make some minor grammatical improvements so as to put the application in better U.S. form.

It is respectfully submitted that no new matter has been added, and it is respectfully requested that the amendments to the specification be approved and entered.

THE REJECTED CLAIMS

Claims 1-6 have been amended to more positively recite the features of the present invention in better U.S. form and to make minor grammatical and/or to correct minor antecedent basis problems. In addition, claim 1 has also been amended to better comply with the requirements of 35 USC 112, second paragraph,

taking into account the Examiner's comments in item 5 of the Office Action. These amendments, however, are not related to patentability and do not narrow the scope of the claims either literally or under the doctrine of equivalents.

Still further, claim 1 has been amended to clarify that the reinforcement discs (23) have substantially a same outer dimension as the magnet discs (21), as clearly shown in the original drawings.

It is respectfully submitted that no new matter has been added, and it is respectfully requested that the amendments to the claims be approved and entered and that the rejection under 35 USC 112, second paragraph, be withdrawn.

THE PRIOR ART REJECTION

Claims 1-6 were rejected under 35 USC 103 as being obvious in view of the combination of JP 09043418 ("Miura et al") and USP 5,448,123 ("Nilson et al"). These rejections, however, are respectfully traversed with respect to claims 1-6 as amended hereinabove.

In item 7 of the Office Action the Examiner refers to Miura et al as disclosing a motor rotor having "a reinforcement disc 3 of a non-magnetic high-strength material between every second magnet disc". It is respectfully submitted, however, that Miura et al does not show reinforcement discs. Instead, Miura et al merely discloses the use of rings 3 which surround magnet rings 2. Such rings affect the outer dimensions of the rotor and

make the rotor costly to manufacture and assemble, and it is respectfully submitted that the arrangement disclosed in Miura et al merely corresponds to the prior art technique discussed in the Background of the Invention portion of the specification of the present application.

By contrast, according to the present invention as recited in amended claim 1, the reinforcement discs (23) have substantially a same outer dimension as the magnet discs (21).

In addition, it is also noted that the reinforcement forces in Miura et al are transferred to the magnet rings 2 not via friction between the magnet rings 2 and the flanges 3A provided on the external rings 3, but via radial forces between the magnet rings 2 and the external rings 3.

By contrast, according to the present invention as recited in amended claim 1, a frictional engagement is accomplished between the reinforcement discs (23) and the magnet discs (21).

Accordingly, it is respectfully submitted that Miura et al does not at all disclose, teach or suggest the structure of the claimed present invention as recited in amended claims 1-6.

And it is respectfully submitted that the present invention as recited in amended claims 1-6 patentably distinguishes over the teachings of Miura et al, taken singly or in combination with Nilson et al, under 35 USC 103.

* *

In view of the foregoing, entry of this Amendment, allowance of the claims and the passing of this application to issue are respectfully solicited.

If the Examiner has any comments, questions, objections or recommendations, the Examiner is invited to telephone the undersigned at the telephone number given below for prompt action.

Respectfully submitted,

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Version With Markings to Show Changes Made

Rotor for a high speed permanent magnet motor.

Field of the Invention

The invention relates to a rotor for a high speed permanent magnet motor. In particular, the invention concerns a motor rotor comprising a plurality of magnetic discs stacked on a central spindle, a clamping device provided to exert an axial clamping force on said magnetic discs to form an axially pre-tensioned disc packet, wherein each of said magnetic discs is provided with at least one electrically insulating layer for electrical separation relative to adjacent discs or to said clamping device.

Background of the Invention

It is a fact that permanent magnetic materials used in motor rotors are exposed to a high centrifugal stress, and that the tension strength limit of such materials is easily reached at high speed operation. This means that permanent magnetic rotors have to be reinforced to cope with the high centrifugal stresses generated at high speed operation.

A previously known method to reinforce permanent magnet rotors is to provide an outer sleeve enclosing the permanent magnetic material parts of the rotor. Such sleeve may comprise a high-strength metal tube made of ~~on~~ a non-magnetic material like ~~titan~~ titanium, cold worked stainless steel, etc. or may be formed of a high-strength fiber bandage wound around the permanent magnet parts of the rotor. In both cases the reinforcement is radially pre-tensioned to minimize the tension stress on the magnetic material caused by centrifugal forces during operation of the motor.

In small diameter rotor applications, an outer reinforcement sleeve is undesirable since it adds to the diameter of the rotor. It is undesirable also from the manufacturing cost point of view, because the sleeve not only adds one or more details to the rotor, it also adds a

number of extra working operations when assembling the rotor.

Summary of the Invention

In order to solve the ~~The~~ above mentioned problems, ~~are solved by~~ the present invention provides ~~since~~ a permanent magnet rotor ~~according to the invention~~ which does not ~~involve~~ have any outer sleeve~~, but~~. Instead, the permanent magnet rotor of the present invention comprises a reinforcement means which does not influence ~~on~~ the diameter of the rotor and which does not complicate the assemblage of the rotor.

A preferred embodiment of the invention is below described in detail with reference to the accompanying drawings.

Brief Description of the Drawings

~~On~~ In the drawings:

Fig. 1 shows, partly ~~i~~ in section, a side view of a motor having a rotor according to the invention.

Fig. 2 shows a longitudinal section through a rotor according to the invention.

Fig. 3 shows, on a larger scale, a fractional view of the rotor in Fig. 2 illustrating schematically the magnet disc arrangement according to the invention.

Fig. 4 shows a rotor according to the invention having a reinforcement disc between every second magnetic disc.

Detailed Description

The motor illustrated in ~~the drawing figures~~ Figs. 1 - 4 comprises a stator 10 including a cylindrical casing 11, two end walls 12,13, electrical windings 14 and a tubular core 15 surrounding the windings 14, and a rotor 16. The rotor 16 is journalled in two bearings 18,19 supported in the stator end walls 12,13 and comprises a central spindle 20, a plurality of permanent magnet discs 21 provided on each side with a layer 22 of electrically insulating material, and a number of reinforcement discs 23 located between the magnet discs 21. The purpose and functional features of the reinforcement discs 23 will be described in further detail below.

action accomplished by the clamping device 24-26,28 frictionally engages each side of the magnet discs 21. This frictional engagement results in a transfer of centrifugal forces from the magnet discs 21 to the reinforcement discs 23 resulting in a tensile stress relief in the magnet discs 21.

In order to fulfil this task, the reinforcement discs 23 are made of a high-strength material such as high-strength metal, ceramic, composite etc. which is very stiff to tensile forces. Accordingly, the coefficient of elasticity of these materials is very high.

In some cases, where the centrifugal forces are not too high and/or the magnet discs 21 are thin, it might be enough to use a reinforcement disc 23 between every second magnetic disc 21 only (see Fig. 4).

If the magnet discs 21 are thin, it may also be enough to use an electrically insulating layer 22 between every second magnet disc 21 only.

As appears from the drawing figures, the magnetic discs 21 as well as the reinforcement discs 23 are of a flat shape and the centrifugal forces appearing in the magnetic discs 21 are transferred by pure friction to the reinforcement. Using pure flat discs is advantageous in that the discs are easily manufactured from sheet material. Machining the discs into other shapes would be very difficult since the high-strength material in the reinforcement discs 23 is very hard to work. It is conceivable, though, to use conical discs such that the frictional engagement between the magnetic discs 21 and the reinforcement discs 23 is amplified by a radial wedge action between the discs.

VERSION WITH MARKINGS TO SHOW CHANGES MADE

Claims 1-8 have been amended as follows:

1. (Amended) [Rotor] A rotor for a high speed permanent magnet motor comprising:

a central spindle [(20)],

a plurality of magnet discs [(21)] stacked on said spindle, [(20), said spindle (20) having]

a clamping device [(24-26,28)] provided on said spindle for exerting an axial clamping force on said magnet discs [(21)], thereby forming an axially pre-tensioned disc packet, and [characterized in that between at least every second magnet disc (21) and/or between one magnet disc (21) and said clamping device (24-26,28) there is located]

a reinforcement disc [(23)] of a non-magnetic high-strength material provided at least one of (i) between at least every second magnetic disc, and (ii) between at least one of said magnetic discs and said clamping device,

wherein the reinforcement discs have substantially a same outer dimension as the magnet discs, and

wherein each reinforcement disc [(23) being] is clamped by said axial clamping force between said at least every second magnet disc [(21)] or between said at least one magnet disc [(21)] and said clamping device [(24,26,28)], thereby accomplishing a frictional engagement between said reinforcement discs [(23)] and said magnet discs [(21)] for transferring

centrifugal forces from said magnet discs [(21)] to said reinforcement discs [(23)], and thereby relieving said magnet discs [(21)] of tensile stress.

2. (Amended) [Rotor] A rotor according to claim 1, wherein [a] one said reinforcement disc [(23)] is located between every two adjacent magnet discs [(21)].

3. (Amended) [Rotor] A rotor according to claim 1 or 2, wherein each one of said magnet discs [(21)] comprises at least one electrically insulating layer [(22)].

4. (Amended) [Rotor] A rotor according to claim 1, wherein said reinforcement discs [(23)] are flat in shape.

5. (Amended) [Rotor] A rotor according to claim 1, wherein said reinforcement discs [(23) consists of] comprise a high-strength metal.

6. (Amended) [Rotor] A rotor according to claim 1, wherein said reinforcement discs [(23) consists of] comprise a ceramic material.

7. (Amended) [Rotor] A rotor [according to claim 1,] comprising:

a central spindle,

a plurality of magnet discs stacked on said spindle,

a clamping device provided on said spindle for exerting an axial clamping force on said magnet discs, thereby forming an axially pre-tensioned disc packet, and

a reinforcement disc of a non-magnetic high-strength material provided at least one of (i) between at least every second magnetic disc, and (ii) between at least one of said magnetic discs and said clamping device,

wherein each reinforcement disc is clamped by said axial clamping force between said at least every second magnet disc or between said at least one magnet disc and said clamping device, thereby accomplishing a frictional engagement between said reinforcement discs and said magnet discs for transferring centrifugal forces from said magnet discs to said reinforcement discs, and thereby relieving said magnet discs of tensile stress,

wherein said magnet discs [(21)] are radially pre-tensioned by a pre-assembly heat treatment of said reinforcement discs [(23)].

8. (Amended) [Rotor] A rotor according to claim 7, wherein [the] a thermal coefficient of expansion [for the material] of the reinforcement discs [(23)] is higher than [that] a thermal coefficient of expansion of the [material of the] magnet discs [(21)], and said heat treatment comprises [a heating-up of the complete] heating the rotor assembly before applying said axial clamping force.